



May 24, 2011

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LaCroix Davis LLC (LCD) has been involved with the testing and remedial work performed on various assemblies at the Department of General Services (DGS) building, located at 450 N Street, in Sacramento, California over the past three years. During the course of investigations LCD discovered that the vinyl flooring tiles on the 21<sup>st</sup> floor were de-bonding. The building's tenant, the California State Board of Equalization (BOE), confirmed that the 21<sup>st</sup> floor vinyl floor tiles date from the original construction of the building, approximately twenty years ago. Additionally, the BOE informed DGS of complaints related to ongoing offensive odors of unknown origin on the 21<sup>st</sup> floor.

LCD forensic architect, Gordon M. Bizieff, was retained to assist with the research, analysis and preparation of recommendations to address the issues of de-bonding and the odors associated with the 21<sup>st</sup> floor vinyl flooring. Results of the research and analysis are summarized below and followed by LCD's recommendations.

#### **CSI TESTING AND LCD RESEARCH AND ANALYSIS**

During April of this year, Construction Services and Investigations, Inc. (CSI) performed moisture, relative humidity and pH testing on the 21<sup>st</sup> floor concrete slab. The CSI testing report dated April 26, 2011 presents the results of that testing (see Appendix A). Calcium chloride testing of the concrete slab revealed moisture vapor emitting from the slab at the rate of 3.6 pounds per 1000 square feet over 24 hours. This rate is within the vinyl flooring manufacturer's recommendations and would not be deleterious to vinyl flooring performance. The relative humidity (RH) at the time of testing was documented to be below 75%. The documented RH readings of 75% and below are acceptable levels according to published vinyl flooring manufacturer's recommendations for flooring installation. However, the pH testing performed by CSI following ASTM F710 requirements documented pH levels in excess of 9.0 for ten out of the twelve locations tested. Multiple commercial flooring manufacturers, including Armstrong and Congoleum, have published maximum pH levels of 9.0 for their products and recommend testing concrete for pH levels prior to installation of vinyl floor coverings.

A report published in *Polymer Degradation and Stability* (Vol. 93, Issue 2, 2007), "Degradation of Floor Adhesives as a Function of pH", by Anderberg and Wadso, explores the condition of pH-related degradation of floor adhesives on concrete substrate through laboratory testing. The report concludes that high pH readings in the range of 11-13 can degrade vinyl flooring adhesives and create odors. The results of the CSI testing on the 21<sup>st</sup> floor eliminate current high moisture as a potential cause and establish high pH as a possible source of the vinyl flooring conditions. The high pH levels are likely due to previous high moisture from inadequately cured concrete that was trapped by the installation of the vinyl flooring. The laboratory testing report cited above, along with the CSI testing and on-site observations of conditions, points to the reaction between high pH levels in the concrete and the vinyl flooring adhesive as the reason for the conditions occurring with the vinyl floor tile on the 21<sup>st</sup> floor.

The CSI report recommends the installation of Koester's concrete sealing products. Product literature for Koester VAP I pH<sup>®</sup> product claims that the product can seal concrete slabs to isolate the pH issue from the vinyl flooring adhesive. The manufacturer states that, "most flooring adhesives will adhere to the Koester VAP I pH<sup>®</sup> product." The manufacturer also warns; 1) do not install product over any gypsum-based products and 2) that the use of water based flooring adhesives will require the additional installation of an approved underlayment system approved by the vinyl flooring manufacturer. Koester warrants their Koester VAP I pH<sup>®</sup> product for 10 years when installed by an approved applicator. CSI also recommends this product as a concrete sealer.

### **CES VOLATILE ORGANIC TESTING**

Further testing was conducted by Dr. C.E. Schmidt (CES) on May 2, 2011 to assess air emissions of odor and odor-related compounds from surfaces identified as a potential odor source during the CSI testing. A report summarizing the findings is attached in Appendix B. The CES investigation included surface flux measurements and ambient air testing on Floors 19, 21, and 22. Three different surface conditions were tested: 1) Floor slab with vinyl composite tiles (VCT) removed and adhesive scraped off; 2) Decomposing VCT as found; and 3) Adhesive exposed due to decomposing VCT.

Flux chamber testing was conducted on the 21<sup>st</sup> floor in the mail center room 21B at two locations on bare slab after VCT were removed and adhesive was scraped off. One ambient air sample was collected from the room center and analyzed for the presence of volatile organic compounds (VOC) and microbial volatile organic compounds (MVOC). The purpose of the testing was to assess the off-gassing of odors and odor related compounds from the slab post VCT and adhesive removal, demonstrating the effectiveness of the tile remedial activity.

## RECOMMENDATIONS

Further research did not reveal a need or a practical method for neutralizing the high pH condition that has been documented. However, it did reveal an extensive case history developed by both manufacturers and contractors that have successfully isolated the condition to a point where it does not affect the bonding of floor products to the slab.

Therefore LCD recommends the following:

Select a location on the 21<sup>st</sup> floor slab where high pH was measured by CSI. Prepare an on-site mock-up to test the performance of the proposed flooring assembly using the Koester's concrete sealer over the slab. The test mock-up should be an exposed four foot square section of concrete slab without cracks. The slab should be prepared for application of the Koester VAP I pH<sup>®</sup> product per Koester's specifications. Once properly applied and cured, a pH test per ASTM F710 should be performed to test the pH level, which must be below 9.0. Once it is established that the test location pH is below 9.0, the test location can be divided into two equal portions. One portion will receive the vinyl flooring and adhesive directly over the Koester's sealer and the other will receive an underlayment approved by Koester's and the flooring manufacturer installed over the sealer and prior to installation of the vinyl flooring and adhesive. The addition of an underlayment to the test will determine if it is preferable to have a protective layer for the Koester product to facilitate the future removal and replacement of the flooring.

Pull tests can be performed on the vinyl tiles to confirm adhesive bond between the vinyl flooring and underlayment and vinyl flooring to the Koester concrete sealer coating to conclude the mock-up test. Upon concluding a successful mock-up test, DGS may consider the two installation options for floor areas to receive vinyl floor tiles.

## LIMITATIONS AND QUALIFICATIONS

1. The assessment performed by LCD does not include or cover the following matters: Matters that are subsequently discovered that could not have been reasonably foreseen or detected, using industry standards, during the performance of the assessment. Matters that could not have been discovered by LCD because of barriers, lack of access or other matters affecting accessibility. Matters that were not disclosed to LCD prior to, during, or after the performance of the assessment. Any new deficiency that arose after the completion of the assessment by LCD.
2. To the extent that additional information becomes available to LCD, LCD reserves the right (without any obligation to do so) to modify its evaluation and/or this Report at any time, based upon further review and analysis of any such additional information or data.

3. Certain items mentioned in the Report were performed by others not involving the supervision of, or management by, LCD, but were relied upon by LCD in making its evaluation and assessment.
4. The assessment performed by LCD is not meant or intended to supplement, modify, or extinguish any warranty or representation made or given by third parties performing any of the recommended corrective work.
5. When consultation involves microbiological growth, or any assessment thereof, such microbiological growth may reoccur if the source of the growth is not remedied. All remediation of fungi in indoor environments can be inherently limited in the sense that conclusions are drawn and recommendations developed from information obtained from limited research and site evaluation. Except as may be noted in the assessment performed by LCD, subsurface areas, latent defects, or non-accessible areas and conditions were not field investigated and may differ from the conditions implied by the surface observations. Additionally, the passage of time may result in a change in the environmental characteristics at the subject property and the surrounding properties. No investigation or assessment can absolutely rule out the existence of any microbiological growth at any given site. LCD does not remediate or remedy sources of microbiological growth.
6. This Report and the assessment/survey conducted by LCD is prepared, and was performed, solely for the use and benefit of the client identified at the beginning of this Report. No other party may rely on this Report for any other purpose.

Report prepared by,

Gordon M. Bizieff, Architect

#### **Appendices**

- Appendix A: [Construction Services & Investigations, Inc.  
Concrete Slab Testing Report \(4/26/2011\)](#)
- Appendix B: [CE Schmidt Technical Memorandum  
Results of the May 2, Surface Flux Chamber Testing and Ambient Air  
Testing at the DSG Building Located in Sacramento, California \(5/16/2011\)](#)
- Appendix C: [Koester VAP 1<sup>®</sup> pH Specification Section 09699](#)